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DECLARATION

I, NOBUAKI KATO, a Japanese Patent Attorney registered No.8517, of Okabe International Patent Office at No. 602, Fuji Bldg., 2-3, Marunouchi 3-chome, Chiyoda-ku, Tokyo, Japan, hereby declare that I have a thorough knowledge of Japanese and English languages, and that the attached pages contain a correct translation into English of the priority documents of Japanese Patent Application No.2000-380572 filed on December 14, 2000 in the name of CANON KABUSHIKI KAISHA.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that wilful false statements and the like so made, are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such wilful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed this 29th day of August, 2002

NOBUAKI KATO

PATENT OFFICE
JAPANESE GOVERNMENT

This is to certify that the annexed is a true copy of the following application as filed with this office.

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Application Number: Japanese Patent Application No. 2000-380572

Applicant(s): CANON KABUSHIKI KAISHA

January 11, 2002
Commissioner,
Patent Office Kozo Oikawa

(Seal)

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2000-380572

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Identification No. [000001007]

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380572/2000

[Name of the Document] Specification

[Title of the Invention] TAB Tape, and Semiconductor Apparatus and Solid-state Image Pickup Apparatus and System Using the Same

[Claim(s)]

[Claim 1] A TAB tape having a lead whose tip is connected to a pad electrode between a semiconductor chip with a stud bump formed on said pad electrode and a protective member for protecting said semiconductor chip,

wherein said lead has an anchor hole formed in a portion in contact with a sealant for sealing between said protective member and said semiconductor chip in a peripheral portion of the semiconductor chip.

[Claim 2] The TAB tape according to Claim 1, wherein said anchor hole is formed with the width in accordance with the flow resistance of said lead and the width at the rear anchor side.

[Claim 3] The TAB tape according to Claim 1 or 2, wherein said anchor hole has a slit shape such as a circle, an elongated circle, an oval, and an elongated oval, and is formed on a plate lead.

[Claim 4] A semiconductor apparatus comprising a semiconductor chip electrically connected to a lead on a TAB tape and a protective member for protecting said

semiconductor chip, which are sealed with a sealant in a peripheral portion of said semiconductor chip,

wherein said lead has an anchor hole formed in a portion in contact with said sealant.

[Claim 5] A solid-state image pickup apparatus comprising a solid-state image pickup element chip carrying solid-state image pickup elements electrically connected to a lead on a TAB tape and a protecting member for protecting said solid-state image pickup element chip, which are sealed with a sealant in a peripheral portion of said solid-state image pickup element chip,

wherein said lead has an anchor hole formed in a portion in contact with the sealant.

[Claim 6] The solid-state image pickup apparatus according to Claim 5, wherein at least a part of said anchor hole is formed in a region where a portion of the lead is sandwiched between said solid-state image pickup element chip and said protecting cap.

[Claim 7] The solid-state image pickup apparatus according to Claim 5 or 6, wherein at least one of a layer for preventing reflection of external light and a layer for preventing multiple reflection is formed between said lead and said protecting member.

[Claim 8] A solid-state image pickup system comprising:

a solid-state image pickup apparatus as set forth

in either one of Claims 5 to 7;

an optical system for focusing light on said solid-state image pickup apparatus; and

a signal processing circuit for processing an output signal from said solid-state image pickup apparatus.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a TAB tape, and a semiconductor apparatus and a solid-state image pickup apparatus and a system using the tape and, more particularly, to a tab tape used in image input devices such as video cameras, digital still cameras, and so on, and a semiconductor apparatus and a solid-state image pickup apparatus and a system using the tape.

[0002]

[Prior Art]

Conventionally, CCD image pickup elements or MOS image pickup elements, which are used in the image input devices such as the video cameras, digital still cameras, and the like, are often formed on a semiconductor substrate such as a silicon wafer or the like. On the silicon wafer after completion of semiconductor steps, color filters and microlenses are made of an acrylic material in the order named, in color filters and microlens forming steps.

[0003]

Then a solid-state image pickup element chip cut into desired dimensions in a post-step is housed in a ceramic package or the like, the chip is electrically connected to leads by wire bonding, and a cap of a glass substrate is bonded onto the package.

[0004]

Fig. 7 is a schematic, cross-sectional view of a conventional solid-state image pickup apparatus. As shown in Fig. 7, in the conventional solid-state image pickup apparatus a solid-state image pickup element chip 2 is provided with a plurality of solid-state image pickup elements such as CCD image pickup elements or MOS image pickup elements placed with their photoreceptive regions facing up, and microlenses 12 for focusing light on the image pickup elements, and leads 3, which are, for example, of copper foil sandwiched between insulating base films 8, 9 such as polyimide films, glass epoxy tapes, or the like, are electrically connected through Au bumps 4 on the solid-state image pickup element chip 2.

[0005]

Further, a cover glass 1 is placed in parallel with and at a predetermined distance from the chip on the photoreceptive region side of the solid-state image pickup elements and is coated with one type or two types of thin films with a different index of

refraction, called AR coat (Anti-Reflection Coating) 7a, and one surface of the cover glass 1 is bonded through a shield thin film 7b to the solid-state image pickup element chip 2 with the leads 3 connected thereto, with a sealant 5 such as an epoxy sealant or the like, filled with a filler in a high density. The solid-state image pickup apparatus using such leads 3 can be made more compact and thinner, for example, than ceramic packages produced by wire bonding.

[0006]

Incidentally, since the bonding power is weak between the sealant 5 and Au plating laid on the surfaces of leads 3, delamination occurs readily between these. When interfacial delamination occurs, there is a problem of reliability that moisture supplied under operating circumstances of semiconductor apparatus becomes easier to penetrate the surfaces of the semiconductor element mounted therein and corrode wires and electrodes on the devices, so as to cause electrical shorts or opens readily. It is thus necessary to prevent the bonding power from becoming weakened between the sealant 5 and the leads 3.

[0007]

[Problem to be Solved by the Invention]

Fig. 8 is a plan view of a lead 3 of TAB tape 11. Fig. 8 shows magnitudes of flow rates of the sealant 5 delivered, by arrows. The sealant 5 flowing on the

lead 3 flowed at lower rates than the sealant 5 flowing in the regions other than the region on the lead 3, as shown in Fig. 8. This is due to the difference between the flow resistance on the lead 3 and the flow resistance in the regions other than the lead 3.

[0008]

Then the sealant 5 flowing in the regions other than the region on the lead 3 turns about at the tip of the lead 3 because of the difference of flow rates of the sealant 5 and the like, and collides with the sealant 5 having flowed on the lead 3. On that occasion, air is taken into the sealant in the merging region to make bubbles on the lead 3, i.e., in an oval region of Fig. 8.

[0009]

If there appear bubbles on the lead 3, the bonding power will become weakened between a coating layer 7 and the lead 3, so as to cause delamination between them, make a leak path between the inside and the outside of the package, and result in dew condensation due to moisture transmission in the package in certain cases and failure in securing electrical conduction or the like of the solid-state image pickup apparatus.

[0010]

It is, therefore, an object of the present invention to provide a TAB tape that is prevented from producing bubbles on the leads.

[0011]

[Means for solving the Problem]

In order to solve the above-mentioned problem, an aspect of the present invention is a TAB tape having a lead whose tip is connected to a pad electrode between a semiconductor chip with a stud bump formed on the pad electrode and a protective member for protecting the semiconductor chip, wherein the lead has an anchor hole formed in a portion in contact with a sealant for sealing between the protective member and the semiconductor chip in a peripheral portion of the semiconductor chip.

[0012]

Another aspect of the present invention is a semiconductor apparatus comprising a semiconductor chip electrically connected to a lead on a TAB tape and a protective member for protecting the semiconductor chip, which are sealed with a sealant in a peripheral portion of the semiconductor chip, wherein the lead has an anchor hole formed in a portion in contact with the sealant.

[0013]

Still another aspect of the present invention is a solid-state image pickup apparatus comprising a solid-state image pickup element chip carrying solid-state image pickup elements electrically connected to a lead on a TAB tape and a protecting member for protecting

the solid-state image pickup element chip, which are sealed with a sealant in a peripheral portion of the solid-state image pickup element chip, wherein the lead has an anchor hole formed in a portion in contact with the sealant.

[0014]

Still another aspect of the present invention is a solid-state image pickup system comprising a solid-state image pickup apparatus as set forth in either one of Claims 5 to 7, an optical system for focusing light on the solid-state image pickup apparatus, and a signal processing circuit for processing an output signal from the solid-state image pickup apparatus.

[0015]

[Embodiment(s)]

The embodiments of the present invention will be described below with reference to the drawings.

[0016]

(Embodiment 1)

Fig. 1 is a schematic, perspective view of a solid-state image pickup apparatus as Embodiment 1 of the present invention. In the solid-state image pickup apparatus of the present embodiment, as shown in Fig. 1, a TAB tape 11 is connected through Au bumps 4 on pad electrodes 15 of a solid-state image pickup element chip 2 in which a plurality of solid-state image pickup elements such as the CCD image pickup elements or the

MOS image pickup elements are mounted.

[0017]

The TAB tape 11 is provided with an insulating base film 8, such as a polyimide film, a glass epoxy tape, or the like, and has leads 3 of copper foil or the like on which anchor holes 6 are formed. Each of the leads 3 is connected at an inner lead 3a part to an Au bump 4 and is connected at outer lead 3b part with the insulating base film 8.

[0018]

The solid-state image pickup element chip 2 is disposed in device hole 10 while being kept in a state in which it is coupled to a cover glass 1 being a protecting member provided with one type or two types of thin films with a different refractive index, called an AR coat (Anti-Reflection Coating).

[0019]

Fig. 2 is a schematic, cross-sectional view of Fig. 1. The solid-state image pickup apparatus of the present embodiment is provided with microlenses 12 on the solid-state image pickup element chip 2 and the AR coat 7a is provided as described above. The cover glass 1 is equipped with a shield thin film 7b. The cover glass 1 side and the solid-state image pickup element chip 2 side are bonded to each other with the sealant 5, such as an epoxy based sealant or the like, filled with a filler in a high density, and a coating

layer 7 is formed between the leads 3 and the cover glass 1. Numeral 9 is an insulating film which is optionally disposed on leads 3 in an opposite side of the insulating base film 8. In Fig. 2, portions similar to those in Fig. 1 are denoted by the same reference symbols.

[0020]

Fig. 3 is an enlarged view of the peripheral portion of the solid-state image pickup element chip 2 of Fig. 2. As shown in Fig. 3, the anchor holes 6 are formed so as to be wholly placed under the cover glass 1 in the peripheral portion of the solid-state image pickup element chip 2.

[0021]

Fig. 4 is a plane view of a lead 3 of Fig. 1. The description will be given by dividing the lead 3 into the portion of the outer lead 3c and the portion of the inner lead 3a for convenience' sake, as shown in Fig. 4. Since the anchor hole 6 is formed in the portion of the outer lead 3a, the difference is not too large between flow rates of the sealant 5 flowing on the wide part and the sealant 5 flowing in the regions other than the region on the lead 3.

[0022]

At the portion of the inner lead 3c, since there is no anchor hole 6 formed there, the sealant 5 flowing in this region comes to make a difference of flow rate

from the sealant 5 flowing in the regions other than the region on the lead 3. However, since the flow rates of the sealant 5 are approximately equal, regardless of whether or not on the lead 3, up to the portion of the inner lead 3a as described above, the position of collision between the sealant 5 flowing on the lead 3 and the sealant 5 flowing in the regions other than the region on the lead 3 is located ahead of the lead 3, i.e., in an oval region of Fig. 4, so that there appear no bubbles on the lead 3.

[0023]

Production steps of the solid-state image pickup apparatus of the present embodiment will be described below. First, the TAB tape 11 is produced. The TAB tape 11 is formed by processing a resin tape, e.g., a polyimide tape 8, for example, 50 μm to 125 μm thick and 48 mm wide, by punching with a die or the like to form the device hole 10 being an aperture for mounting of the semiconductor chip and unrepresented perforations being positioning holes for carriage of tape carrier.

[0024]

In the mounting of solid-state image pickup elements using the TAB tape 11, the distance between the solid-state image pickup element chip 2 and the device hole 10 is set as wide as about 1.5 to 2.0 mm in consideration of application of the sealant 5.

Further, in order to maintain high strength of the inner leads 3a of the TAB tape 11 bonded to the Au bumps 4 formed on the solid-state image pickup element chip 2, the portion between the inner lead 3b and the device hole 10 is made wider than the size at the tip.
[0025]

Next, the insulating base film 8 is laminated with rolled copper foil or electroplated copper foil about 18 to 35 μm thick by bonding with an adhesive. Then a photoresist is applied onto the copper foil in order to form patterns and the leads 3, and is then subjected to exposure and development of patterns and the leads 3. After that, a backing resist is applied in order to protect the back surfaces of the inner leads 3a of copper foil exposed in the device hole 10 by punching, from etching. Thereafter, the copper foil is subjected to an etching step to form the patterns and leads 3.
[0026]

The photoresist and backing resist, which become unnecessary after the etching, are dissolved and removed with an alkali solution, and then a solder resist is printed for protection and insulation of the copper wiring patterns except for those in the connection regions. The copper wiring patterns are plated with Sn, Au, or the like by electroplating in order to enhance bonding performance.
[0027]

The anchor holes 6 are produced by a step similar to the step of the copper foil etching of the TAB tape 11. However, the minimum width of the anchor holes 6 is determined as 1.0 X T (T: thickness of copper foil). Further, the anchor holes 6 are formed in the following dimensions: for example, where the width of the inner lead 3c wider than the size at the tip is 35 μm, the longitudinal length of the hole is arbitrary and the transverse length of the hole is, for example, 25 μm.

[0028]

The transverse length of the anchor holes 6 can be determined according to the strength of the lead body, the width of the inner lead 3a, and the flow resistance of the lead body, and the shape of the anchor holes 6 does not have to be limited to the shape of the hole as shown in Fig. 4, but may be, for example, a circular shape having the diameter of 25 μm.

[0029]

Subsequently, the Au bumps 4 are formed on the pad electrodes 15 on the solid-state image pickup element chip 2, the Au bump 4 side is preliminarily heated to about 150°C, and in that state each inner lead 3c of the TAB tape is joined thereto through use of a bonding tool by a single point bonding method. It is preferable that each inner lead 3c of the TAB tape 11 is connected by thermosonic pressure bonding or the like.

[0030]

After that, the cover glass 1 for preventing attachment of dust to the microlenses 12 and others is placed a predetermined distance apart from and in parallel with the solid-state image pickup elements. Then the sealant 5, e.g., a thermosetting resin or an ultraviolet-curing resin is delivered onto the peripheral region of the solid-state image pickup element chip 2 from a dispenser or the like, the cover glass 1 side and the solid-state image pickup element chip 2 side are attached to each other, and the sealant 5 is hardened by thermal cure or irradiation of ultraviolet light.

[0031]

When the sealant 5 is an ultraviolet-curing resin, the shield thin film 7b serves as a mask against ultraviolet light and the sealant is cured under irradiation with ultraviolet light whereby the resin can be prevented from flowing into the effective image pickup area inside the shield thin film 7b. Therefore, the ultraviolet-curing resin is used as the sealant 5 in the present embodiment.

[0032]

(Embodiment 2)

Fig. 5 is a perspective view of a solid-state image pickup apparatus as Embodiment 2 of the present invention and is equivalent to Fig. 3. When Fig. 5 is

compared with Fig. 3, the longitudinal length of the anchor holes 6 is different. Namely, the anchor hole 6 shown in Fig. 3 is formed in the size wholly placed under the cover glass 1, whereas the anchor hole 6 shown in Fig. 5 is formed in a size which cannot be accommodated under the cover glass 1.

[0033]

When the anchor hole 6 is formed in the form as shown in Fig. 5, a force exerted on the connection portion between the lead 3 and the Au bump 4 can be weaker than in the case wherein the anchor hole 6 is formed in the form shown in Fig. 3. Namely, the stress is also distributed to the anchor hole 6 side, thereby relatively decreasing the stress applied to the Au bump 4.

[0034]

In the configuration wherein the anchor hole 6 is wholly placed below the cover glass 1, since there is the difference of flow resistances before arrival of the sealant 5 at the anchor hole 6 formed in the inner lead 3c, flow rates are different at the time of application of the sealant, and then the sealant 5 flows at an equal flow rate after arrival at the anchor hole 6. Namely, there arises a time lag though it depends upon the distance of the hole, and this makes impossible to uniform flowing-in.

[0035]

In contrast to it, since the flow resistances are equal between inside the hole and outside the lead 3 in the case of the anchor hole 6 which cannot be accommodated under the cover glass 1, uniformity of flowing-in can be realized in this part.

[0036]

(Embodiment 3)

Fig. 6 is a block diagram of a solid-state image pickup system according to Embodiment 3 of the present invention. In Fig. 6, reference numeral 1001 designates a barrier serving as a protector for a lens and as a main switch; numeral 1002 a lens for focusing an optical image of an object on a solid-state image pickup element 1004; 1003 a diaphragm for variably controlling the quantity of light passing through the lens; 1004 a solid-state image pickup element, as described in Embodiment 1, for capturing the object image focused by the lens 1002, as an image signal; 1005 an image pickup signal processing circuit for effecting processing including various corrections, clamping, etc. on the image signal outputted from the solid-state image pickup element 1004; 1006 an A/D converter for performing analog-digital conversion of the image signal outputted from the solid-state image pickup element 1004; 1007 a signal processing unit for effecting various corrections on the image data outputted from the A/D converter 1006 and compressing

data; 1008 a timing generator for outputting various timing signals to the solid-state image pickup element 1004, to the image pickup signal processing circuit 25, to the A/D converter 1006, and to the signal processing unit 1007; 1009 a whole control-arithmetic unit for wholly controlling various arithmetic operations and the entire still video camera; 1010 a memory for temporarily saving image data; 1011 a recording medium control interface unit for recording or reading data in or out of a recording medium; 1012 a recording medium that can be attached or detached, such as a semiconductor memory or the like, for recording or reading of image data; 1013 an external interface (I/F) unit for communication with an external computer or the like.

[0037]

In the next place, the operation of Fig. 6 will be described. When the barrier 1001 is opened, the main power is turned on. Then the power of the control system is turned on, and the power of the image pickup system circuit including the A/D converter 1006 and others is further turned on. Then, in order to control an exposure amount, the whole control-arithmetic unit 1009 brings the diaphragm 1003 to the full aperture and a signal outputted at this time from the solid-state image pickup element 1004 is guided through the image pickup signal processing circuit 1005 to the A/D

converter 1006. The A/D converter 1006 performs the A/D conversion of the signal and outputs the result to the signal processing unit 1007. The signal processing unit 1007 makes the whole control-arithmetic unit 1009 calculate an exposure based on the data.

[0038]

Brightness is judged based on the result of this photometry and the whole control-arithmetic unit 1009 controls the diaphragm in accordance with the result of the judgment. Next, the whole control-arithmetic unit 1009 calculates the distance to the object by extracting a high-frequency component, based on the signal outputted from the solid-state image pickup element 1004. After that, the lens 1002 is driven and whether focus is achieved is determined. When it is determined that the lens is out of focus, the lens 1002 is again driven and distance measurement is carried out.

[0039]

After an in-focus state is confirmed, regular exposure is started. After completion of the exposure, an image signal outputted from the solid-state image pickup element 1004 is subjected to corrections and others in the image pickup signal processing circuit 1005, and the resultant signal is further subjected to the A/D conversion in the A/D converter 1006. A digital signal obtained is processed in the signal

processing unit 1007 and the whole control-arithmetic unit 1009 stores the resultant in the memory 1010. After that, the data stored in the memory 1010 is recorded through the recording medium control I/F unit 1011 into the detachable recording medium 1012 such as a semiconductor memory or the like under control of the whole control-arithmetic unit 1009. The data may also be guided through the external I/F unit 1013 directly into a computer or the like to be subjected to processing of image.

[0040]

Each of the embodiments of the present invention was described above as an example where the TAB tape 11 was used in the solid-state image pickup apparatus and system, but the TAB tape 11 can also be used in the semiconductor apparatus other than the solid-state image pickup apparatus.

[0041]

As described above, according to the present invention, a lead has an anchor hole formed in a portion in contact with a sealant for sealing between a protective member, which protects a semiconductor chip and the like, and the semiconductor chip in a peripheral portion of the semiconductor chip or a solid-state image pickup element chip, and thereby the flow rates of the sealant flowing on the lead and the other than the lead become almost identical so that

generation of bubbles on the lead can be prevented.

[Brief Description of the Drawings]

[Fig. 1] A schematic, perspective view of a solid-state image pickup apparatus as Embodiment 1 of the present invention.

[Fig. 2] A schematic, cross-sectional view of Fig. 1.

[Fig. 3] An enlarged view of a peripheral portion of a solid-state image pickup element chip of Fig. 2.

[Fig. 4] A plane view of a lead of Fig. 1.

[Fig. 5] An enlarged view of a peripheral portion of a solid-state image pickup element chip in a solid-state image pickup apparatus as Embodiment 2 of the present invention.

[Fig. 6] A block diagram of a solid-state image pickup system as Embodiment 3 of the present invention.

[Fig. 7] A schematic, cross-sectional view of a solid-state image pickup apparatus.

[Fig. 8] A plane view of a lead of Fig. 7.

the parasitic resistance of the thin film transistor

[Description of Reference Numerals or Symbols]

1 Cover glass

2 Solid-state image pickup element chip

3 Lead

3a Inner lead

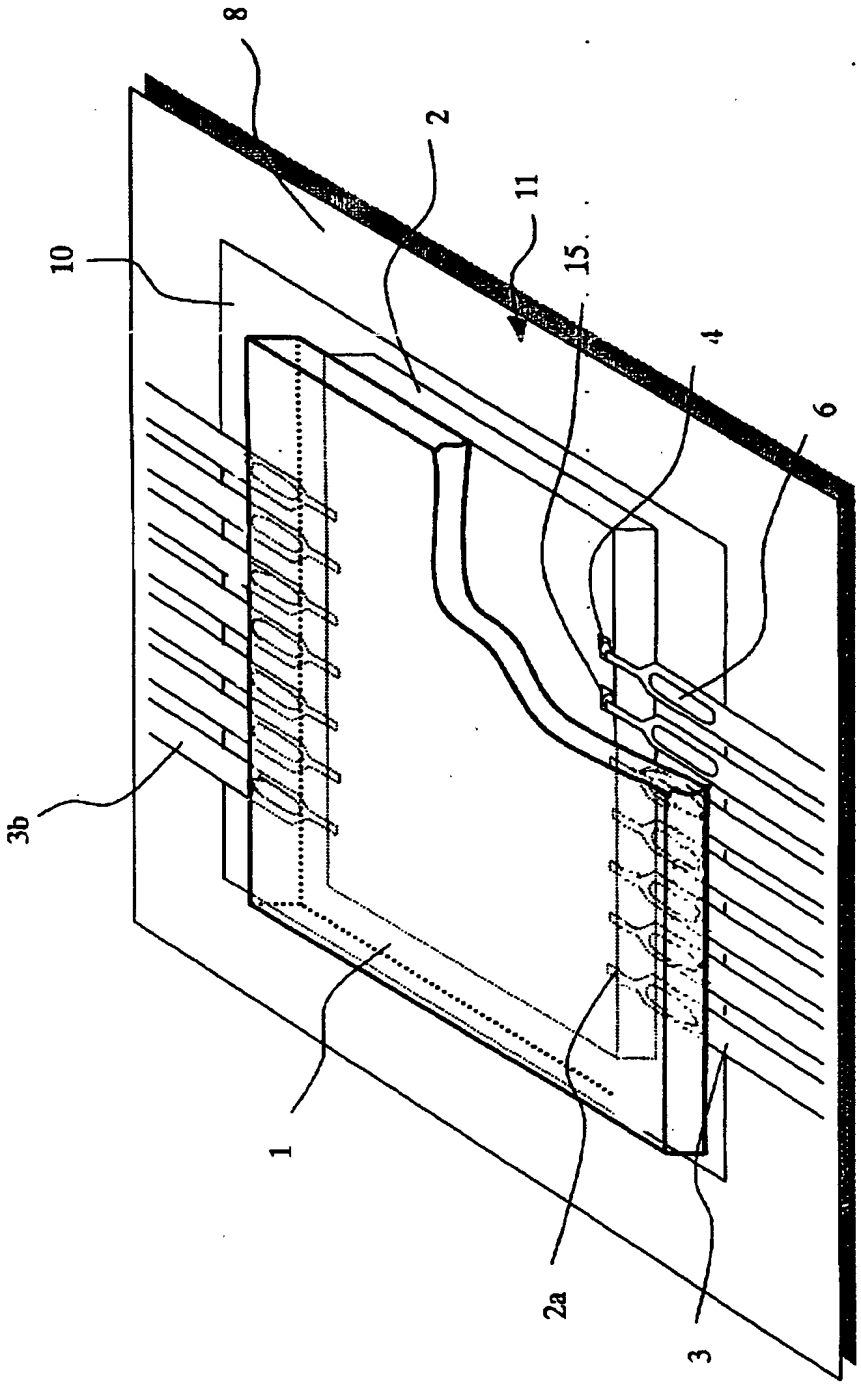
3c Outer lead

4 Au bump

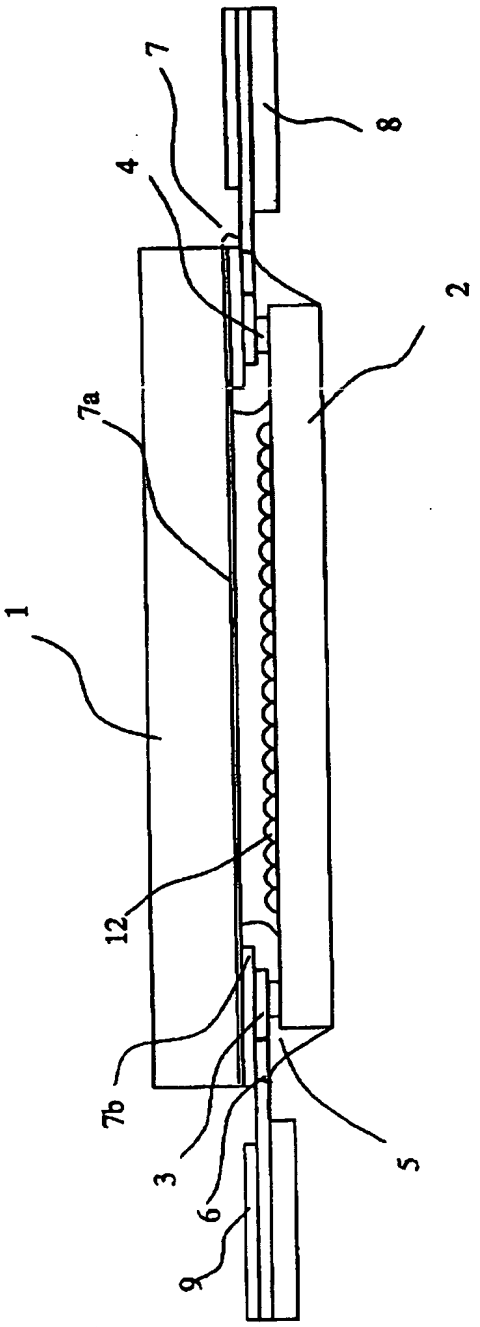
5 Sealant
6 Anchor hole
7 Coating layer
7a AR coat
7b Shield thin film
8 Base film
9 Resist
10 Device hole
11 TAB tape
12 Microlens
13 Sealant flow line
14 Bubble
15 Pad electrode

【書類名】　図面　〔Name of the Document〕 Drawings

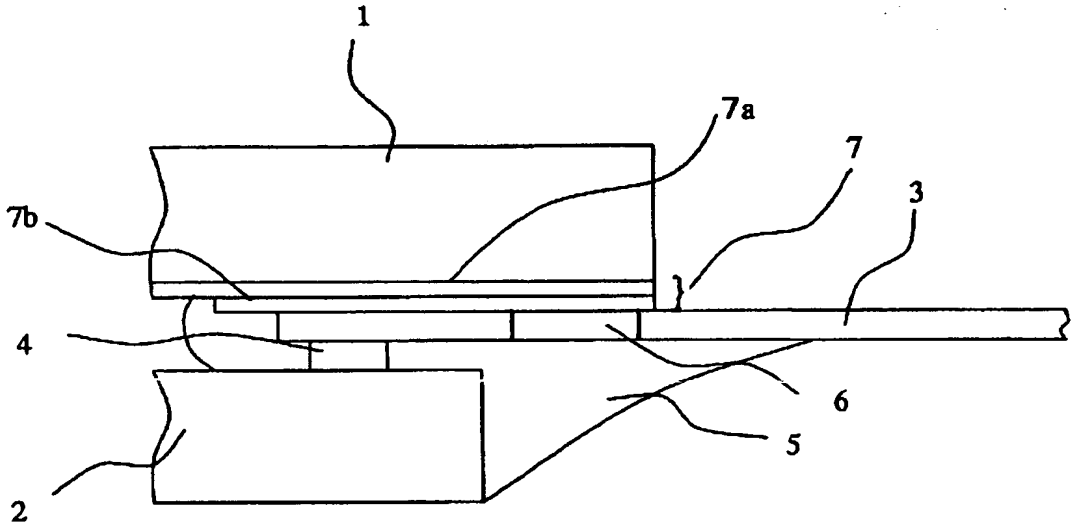
【図１】 Fig. 1



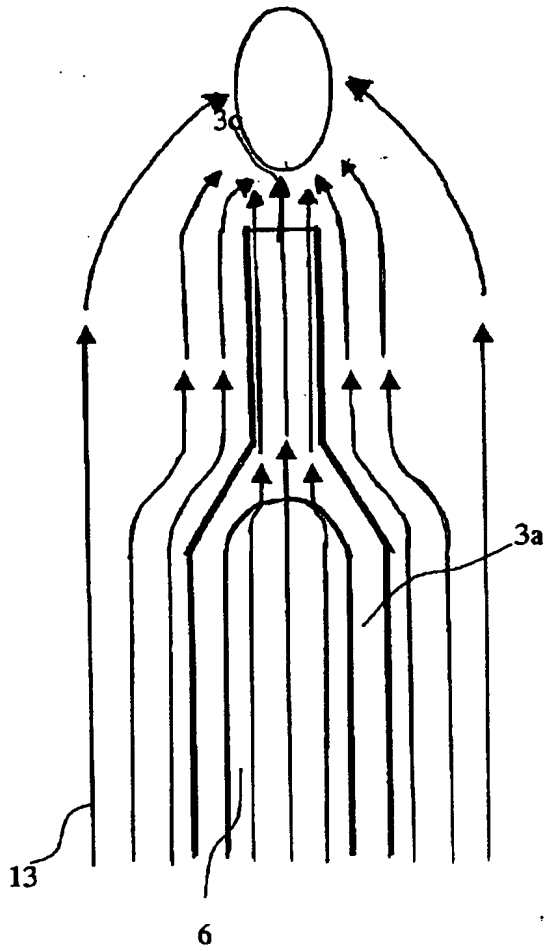
【図２】 Fig. 2



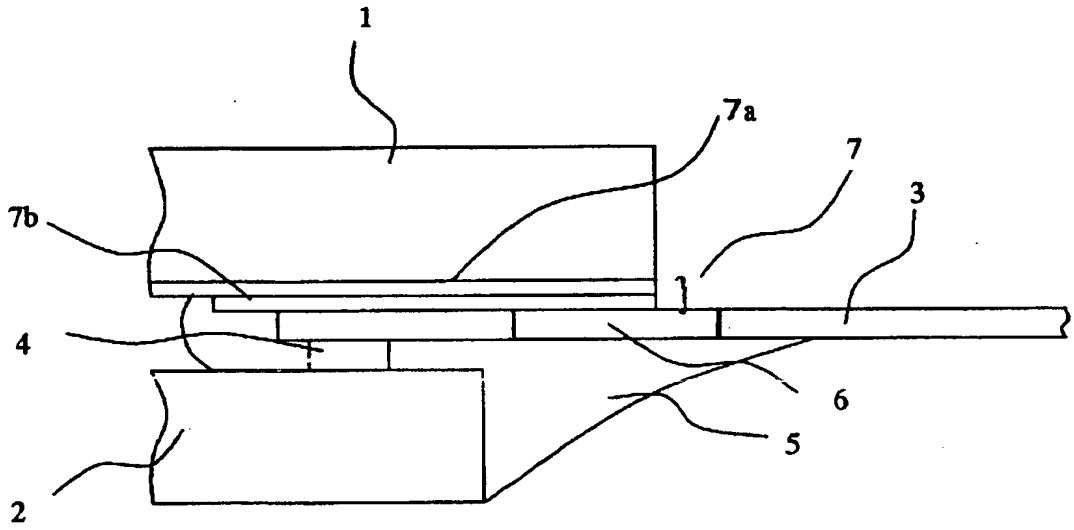
【図３】　Fig. 3



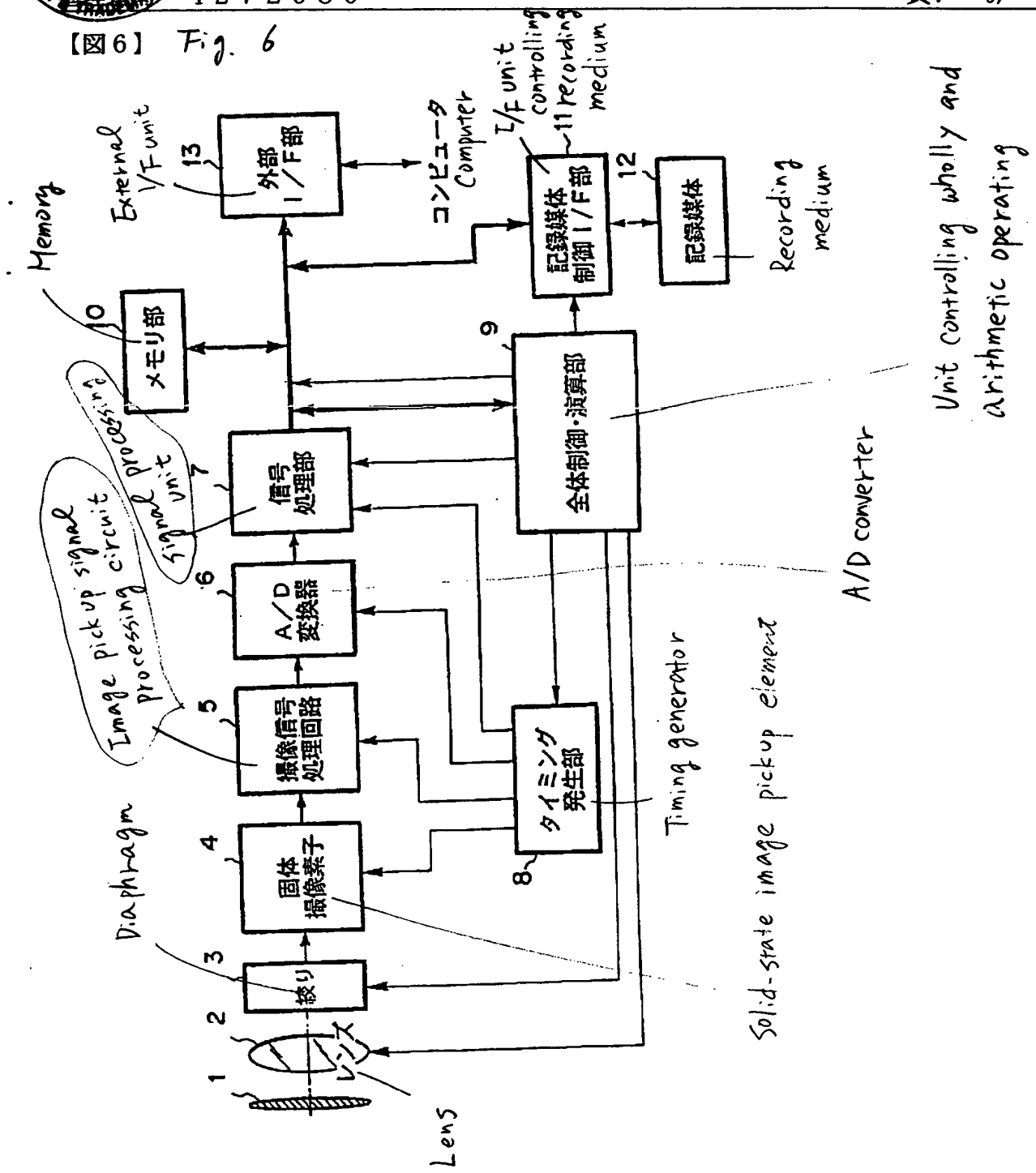
【図４】　Fig. 4



【図５】 Fig. 5

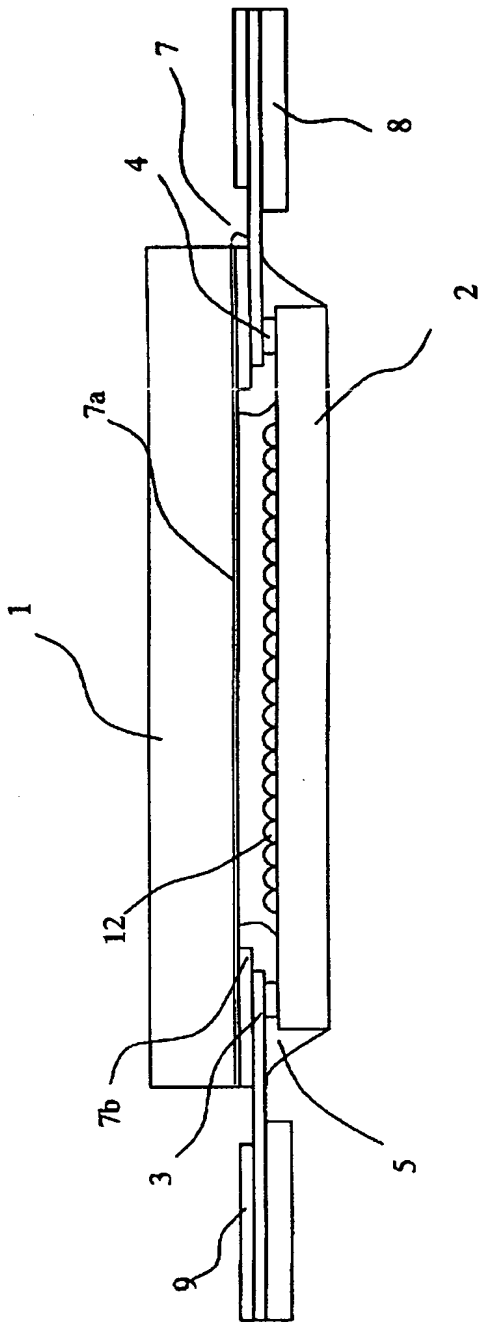


【図6】 Fig. 6

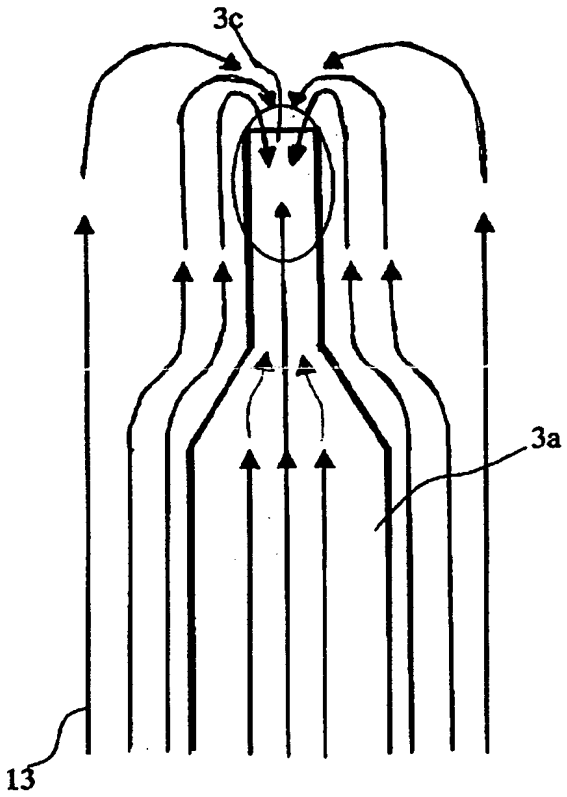


【図７】

Fig. 7



【図８】　Fig. 8



[Name of the Document] Abstract

[Abstract]

[Problem(s)] An object of the present invention to provide a TAB tape that is prevented from producing bubbles on the leads.

[Means for Solving the Problem(s)] In a solid-state image pickup apparatus provided with a solid-state image pickup element chip 2 carrying solid-state image pickup elements electrically connected to leads 3 on TAB tape 11, a protecting member 1 for protecting the solid-state image pickup element chip 2, and a sealant 5 for sealing them in the peripheral part of the solid-state image pickup element chip 2, each lead 3 has an anchor hole 6 formed in a portion in contact with the sealant 5.

[Elected Drawing] Fig. 1